March 10, 1970 P. AUGUST 3,499,427

FUEL-AIR MIXTURE IMPROVEMENT APPARATUS FOR CARBURETORS

Filed June 15, 1967 3 Sheets-Sheet 1

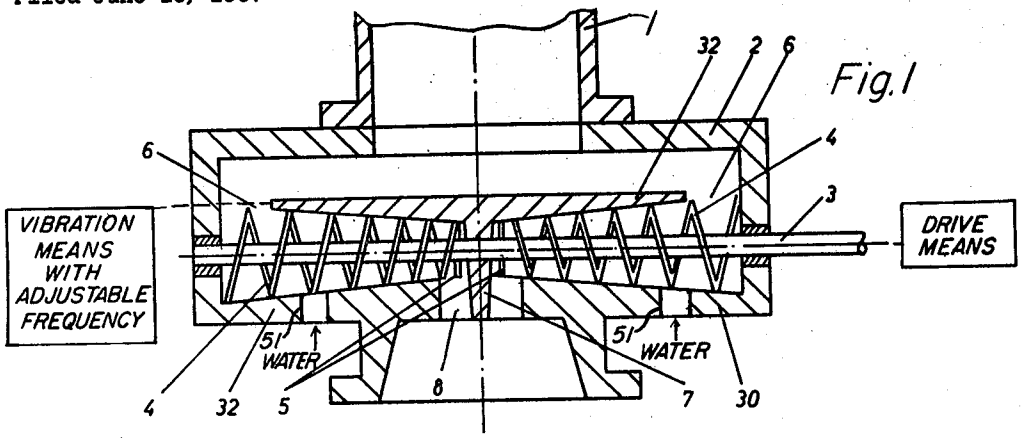


Fig. 1

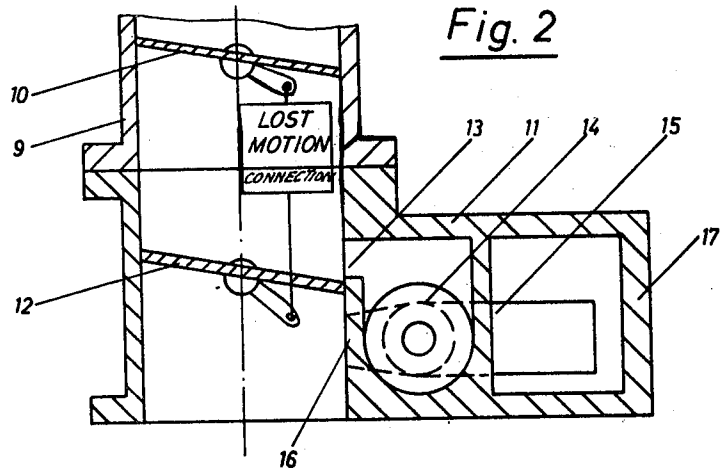


Fig. 2

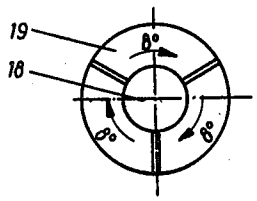
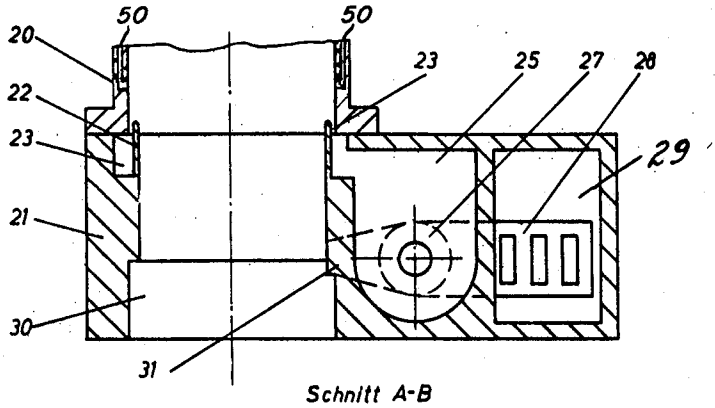


Fig. 3

FUEL-AIR MIXTURE IMPROVEMENT APPARATUS FOR CARBURETORS

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Fig. 4



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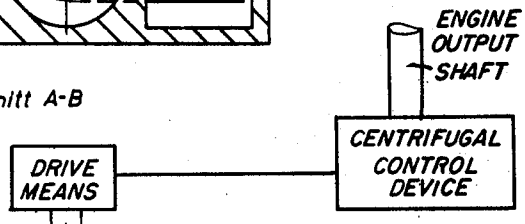
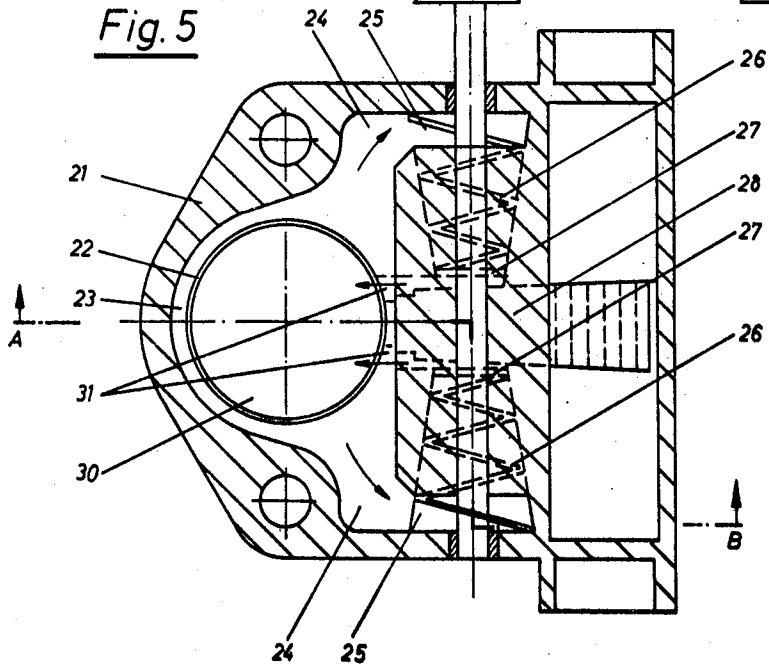


Fig. 5



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FUEL-AIR MIXTURE IMPROVEMENT APPARATUS FOR CARBURETORS

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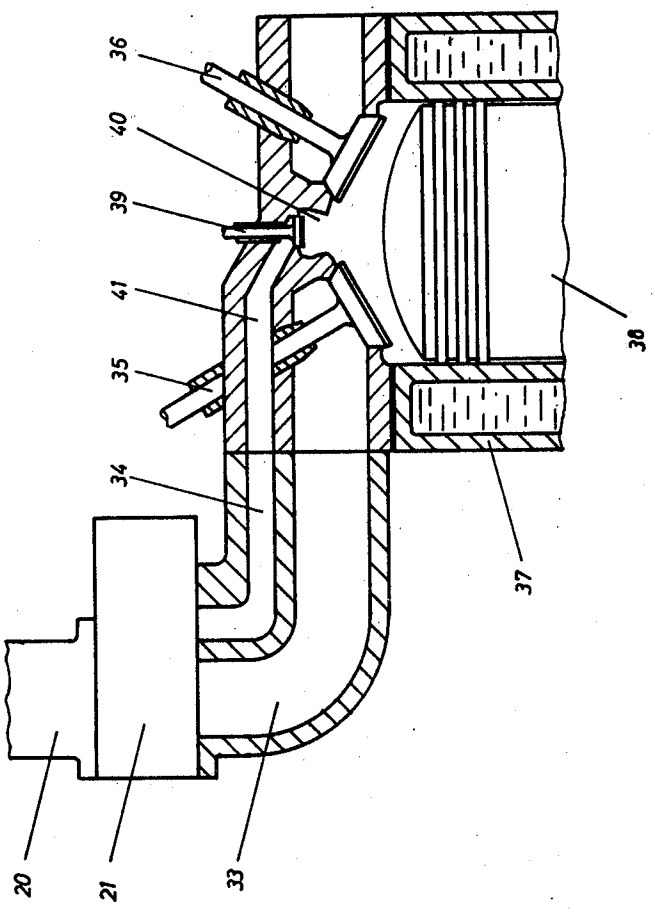


FIG. 6

United States Patent Office

3,499,427

Patented Mar. 10, 1970

3,499,427

FUEL-AIR MIXTURE IMPROVEMENT APPARATUS FOR CARBURETORS

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Filed June 15, 1967, Ser. No. 646,389
Claims priority, application Germany, Nov. 5, 1966, J 32,167; Feb. 14, 1967, J 32,984
Int. Cl. F02m 31/00, 7/00; F02b 75/02
U.S. Cl. 123—122 18 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for the improvement of the mixture formation in internal combustion engines comprising a driven scroll device between the carburetor and the cylinders for compressing the fuel-air mixture and forming a homogeneous condensate which is droplet free and is supplied thusly to the cylinders.

The invention relates to improvements in carburetors or fuel mixture supplies to internal combustion engines and more particularly to the supply of a fine spray of the liquid fuel in the fuel-air mixture connected with a condensation free uniform mixture formation.

It is known that a large portion of the fuel which comes to the wall of the carburetors forms a liquid film which does not, to a great extent, break away until entry into the cylinder. Thus there results an irregular mixture with over rich zones. The carburetors must be so regulated that an excess of fuel is present in the mixture so that the leanest zones are still capable of ignition and combustion. Thereby there results in particular in the lower load and speed range incomplete combustion with CH and CO constituents in the exhaust gas.

The object of the invention is to obviate this drawback. Connected to the carburetors therefore is a driven system with a worm scroll and rotary pressure disc which throws the mixture against a preferably heated baffle plate and undergoes a compression and relieving process. The different arrangements shown construction which subject the whole or part of the mixture to this process. Because of constructional size and driving output it is more advantageous to prepare only a portion of the mixture mainly in the lower speed of rotation and load range or the proportion which contains the film of liquid of the fuel.

There are many proposals with baffle plates which are rotated by the air current of the mixture. The present system is in no way to be compared therewith. In the known methods mixing of the mixture is effected by centrifugal forces which is something quite different from what takes place here. The mixture is compressed in the rigidly rotary scroll which is larger in diameter at the inlet than at the outlet end. In addition the pressure disc of the scroll throws the mixture against a heated baffle plate. The fuel is therefore also displaced in the lower speed of rotation range with the air at great velocity as well as subjected to pressure and impact. Thereby the drops of fuel are reduced to a mist and they are furthermore considerably reduced and thereby finely distributed in the mixture. This manner of operating does not exist in the known proposals.

It has furthermore been found that it is advantageous if the condensate prepared as described above is not led back into the main mixture channel but that the prepared condensate from the main mixing channel of the carburetors removed from its walls and through the scroll if necessary also through the baffle plate is guided through a separate suction channel into the combustion chamber of the engine.

Such a system brings about the enormous advantage

that not only must the fuel from the carburetors be driven but that thereby an engine operating on the Otto cycle can employ a diesel engine fuel and therefore known diesel engines may have a simpler control by a carburetors and with the same output may be made approximately 40% cheaper, smaller and lighter. The engine is thereby unaffected by the fuel octane number and, since the liquid film of fuel is carbureted the fuel is also unaffected in respect of the combustion range of the fuel.

In a further construction of the invention the special suction scroll is heat insulated and heated for the preparation of the prepared fuel guided via the special suction scroll. Thereby a re-condensation of the prepared fuel is avoided.

It is furthermore advantageous for the baffle plate to consist of a material which contributes catalytically to the octane value improvement of the fuel in the vapor phase.

Important for the removal of poisonous exhaust gases is furthermore the fact that means for the addition of water and vapor to the prepared condensate during its preparation is arranged in the area of the scroll.

A preferred embodiment for the supply of the prepared condensate in the combustion chamber provides for a separate inlet valve between the separate suction scroll and the combination chamber.

As the fuel-air mixture fed by the separate suction scroll is efficient and on the other hand the fuel-air mixture fed to the main induction pipe is lean since the portion of fuel drawn off as condensate is removed from this air mixture, a favorable mixing within the combustion chamber can be controlled. For this purpose a combustion chamber with a spark plug is provided at an associated separate inlet valve as a part of the combustion chamber. Only after the mixing of the two supplied fuel-air mixtures in the combustion chamber can the mixtures be ignited and the piston stroke is a participating factor.

For the correct or most favorable mixing in respect of the ignition time a separately regulated opening time of the inlet valve has proved to be satisfactory. For this reason there is arranged control means for the inlet valve which open before the separate inlet valve from the scroll and close later.

A few embodiments of the invention are illustrated diagrammatically and described with reference to the drawing and thereby further features of the invention follow from the drawing and description.

FIGURE 1 shows a construction in which the whole mixture is subjected to the pressure and impact treatment;

FIGURE 2 represents a construction in which the mixture passes through the scroll only in the lower speed and load ranges;

FIGURE 3 shows the shape of the pressure plate;

FIGURE 4 and FIGURE 5 show a construction in which only a liquid film of fuel is drawn with comparatively little air through the scroll and subjected to the pressure and impact treatment; and

FIGURE 6 shows the separate supply of the prepared condensate into a separate combination chamber.

In FIG. 1 there is located below the carburetor **1** a casing **2** in which there is a shaft **3** driven externally. On this shart **3** are mounted two feed scrolls **4** which decrease in diameter from the outside towards the center and terminate at the inner end with a pressure plate **5**. The two scrolls are separated by a baffle plate **7**. The mixture coming from the carburetor enters at high peeed through the openings **6** into the scrolls and due to the decreasing diameter thereof which closely contacts the casing **32**, is compressed.

At the end of the scroll, the mixture is forced at high pressure against the baffle plate **7**, and the last large drops

of the fuel are most finely reduced and a homogeneous condensate and drop-free mixture flows through the openings **8** into the induction pipe of the engine.

Water can be added to the condensate through channels **51** as shown in FIG. 1.

In FIG. 2 a casing **11** with a butterfly valve **12** is located under the carburetor **9** with its throttle valve **12**. Above the closed butterfly valve **12** there is an opening **13** in the wall of the casing in which the scroll **14** with the pressure disc is located. The baffle body **15** projects into a further casing **17** through which exhaust gases are led to heat the baffle body. In the lower speed range the valve **12** is closed and the mixture flows through the opening or openings to the scroll **14**. There as already described, the mixture is prepared and passed through openings **16** below the valve **12** into the induction pipe. The shafts of the valves **10** and **12** are connected by levers interconnected through a lost motion device such that the valve **12** opens later than the valve **10** and more quickly so that when the carburetor throttle valve **10** is fully opened the other valve **12** is fully closed. Beyond a certain speed and load range the lower valve **12** also opens and the mixture flows directly into the induction pipe.

FIG. 3 shows a construction of a pressure plate. The plate includes two, three or more segmental discs **19** which are slanted relative to shaft **18** by a few degrees (5–10°) so as to be helically staggered in the manner of the blades of a propeller. A disc formed as described presses the mixture at high pressure against the baffle plate.

FIGS. 4 and 5 again show the carburetor **20** with the casing **21** located thereunder. Directly below the carburetor, the casing forms a ring **22** which has a somewhat smaller diameter than the bore of the carburetor and projects a few millimeters into the carburetor. The ring **22** bounds inwardly an annular channel **23**, which is connected by means of channels **24** to the inlets **25** of the double scroll **26**. Here also the scroll tapers from the outside to the inside and to the pressure disc **27** at the end. The rear end of the baffle body **28** projects into the exhaust heated chamber **29** and the front end into the suction pipe **30** of the casing **21**. The baffle body **28** closes the inner ends of two outlet openings **31**. It is sharp edged, displaced twice and enlarges the space of the openings inwards while the height of the openings is diminished.

With the advantageous arrangement for the preparation of a portion of the mixture, mainly the liquid film of fuel forming on the wall of the carburetor is fed to the scrolls whereby very little air is contained in this mixture. In the idling and low speed range, the throttle valve of carburetor is almost closed and therefore almost the entire mixture goes through the scroll system. The fuel from the idling jets **50** of the carburetor flows almost completely along the carburetor wall and this comes to the scrolls.

In certain carburetors, upon acceleration, a fuel jet is sprayed on the side lying opposite the idling system in the carburetor. There also a large part reaches the wall and a condensate therein is however prepared and led to a complete combustion.

The openings **31** through which the prepared mixture is pressed by the scrolls with pressure discs again into the suction channel are so formed that this mixture can be raised uniformly with the air in the suction channel. If necessary these openings are longitudinal by means of tubes projecting into the suction channel which tubes may open downwards.

Since in the idling operation with a high suction action a rich idling mixture almost without combustion air is fed to the engine, the supply of fuel will in this operating state be blocked by suitable measures. At the same time, by the same control or by a second control of the same manner of operating, the driving motor for the scroll is switched off. The stopping of the driving motor immediately stops the rotation of the scroll and no further mixture is admitted to the cylinder.

At the moment of acceleration due to a decrease in the partial vacuum—the speed of the driving motor may be greatly increased and one can completely dispense with the accelerator pump in the carburetor or reduce the quantity of injected fuel.

The scroll shaft is driven most advantageously by an electric motor. The desired accelerations or stopping may be controlled best with known and simple means. Since by means of the preparation system according to FIGS. 4 and 5 almost always the same quantity of fuel passes through with little air the speed may be kept constant during idling and a high speed of about 6000 revolutions per minute should be maintained.

The scroll shaft may be driven by a drive means, as shown in FIG. 4, from the outplt of the engine via a centrifugal control device to produce a decreased ratio of speed of rotation of the scroll shaft with respect to engine speed when the engine speed increases. The control device may comprise a simple infinitely variable V-belt drive regulated by means of contrifugal force such that, for example, in the lower speed range the speed ratio increase amounts to about a 1:4 and at the highest speed of the engine only to 1:1 to 1:1.5.

The baffle plates are not exactly at right angles to the scroll shaft but inclined at a few degrees from a right angle that the outlet openings are widened at the outlet.

For improving the preparation of the mixture during idling and in the lower speed range a measured quantity of exhaust gas can be fed to the suction opening of the scrolls.

With the invention the fuel air mixture consisting mainly of the righ condensate and the rich portion of the mixture is due to the high speed, precompression and striking impact effect under high pressure on a heated surface, reduced to a fine mist and partly vaporized. For this a certain energy is necessary and can only be obtained by means of a driven system.

This invention is therefore not to be compared with the known baffle plates, rotating bodies etc., which are placed in the suction current.

This preparation of the mixture mainly of the fuel makes the carburetor motors insensitive to the octane member and the boiling range of the fuel to be used. It is quite possible to drive carburetor motors satisfactorily with kerosene or jet driving fuels.

Of course all equivalent means are included in the invention in particular the conveying and at the same time compressing action attained by the scrolls may be replaced by other mechanically equivalent.

Essential is the fact that as regards the baffle and pressure plates a further feature of the invention consists in that the pressure disc and/or baffle bodies vibrate by known means, for example, electromagnetically.

It is furthermore essential for the vibration frequency to be adjustable.

By this measure furthermore a homogenizing of the mixture is attained when pressure discs and/or baffle bodies are heated as by the relative movement which is associated with the particles.

The embodiment illustrated in FIG. 6 shows a carburetor base **20** with preparation device **21** according to FIGS. 4 and 5 located therebelow. The main mixture passage leads further in to the main induction pipe **33** while the condensate taken from the induction pipe is processed in the preparation device **21** to a fuel-air mixture and is then led into a separate heat insulated inlet pipe **34**. In a multi-cylinder engine several of these inlet pipes **34** corresponding to the number of cylinders lead from the preparation device **21** to the individual cylinders **37** (FIG. 6). The induction pipe **33** leads to a normal inlet valve **35** and from there into the combustion chamber with a piston **38** therein and an exhaust valve **36** disposed

opposite the inlet valve 35. The inlet pipe 34 is designed as a separate suction source likewise leading to the combustion chamber 40 but through a separate valve 39. Into this combustion chamber a spark plug projects which for clearness is not shown.

The embodiment illustrated operates in the following manner: A lean non-ignitable mixture is drawn through the main induction pipe 33 by the piston 38. Through the separate inlet pipe 34 is drawn a likewise non-ignitable mixture which contains about 50% of fuel but only quite a small percentage of combustion air. A premature self ignition of the fuel is therefor not possible even with a low octane number. Only when the piston 38 is almost at the upper dead center and both mixtures have united is the rich mixture in the combustion chamber 40 so diluted that ignition can take place by means of the spark plug.

In order that the rich mixture is not prematurely mixed with the lean mixture during the suction stroke, first of all suction is applied in the usual manner through the inlet valve 35 and the valve 39 only when the piston has reached the lowermost half of its stroke. Likewise the separate suction valve 39 remains open longer than the inlet valve 35. As the rich mixture is placed under pressure by means of the scroll in the preparation device 21 this can also still enter the combustion chamber 40 when the piston 38 is already on the upward stroke (compression stroke). There is therefore present in the combustion chamber 40 actually a rich mixture and the main mixture is very lean until in the last part of the compression stroke a mixing of the mixtures takes place. Nevertheless the mixture around the plug is somewhat richer than the mixture adjacent the piston. Thus a mulitiple stratification is attained in which the mixture around the plug has an ignitable composition while in the remaining portion there is an excess of air. This is the prerequisite for a clean complete combuston which is actually attained and in fact without residence of unburnt poisonous gases and with the low fuel consumption of a diesel engine. The disadvantages of the diesel engine such as heavy and expensive construction, limited speed and low output are obviated.

In order to promote this combustion further, the baffle body in the preparation device 21 is preferably made of a material which contributes catalytically to the octane improvement of the fuel in the vapor phase and in the pressure and temperature ranges. At the entry of the inlet valve chamber in the main induction pipe 33 an additional condensate preparation of the main mixture can be effected by known means when only low grade fuel such as diesel fuel is used.

It is obvious that the apparatus according to the invention can be substituted on existing engines by the exchanging of new cylinder heads on motor cars of any kind to effect conversion to the fuel preparation according to the invention.

What is claimed is:

1. In an internal combustion engine having a carburetor for the supply of a fuel-air mixture to each cylinder of the engine, an improvement comprising a device between the carburetor and the cylinder of the engine including first means for the guidable passage of the fuel-air mixture along a deviate path from that between the carburetor and the cylinder and second means in said passage for forceably advancing the mixture while compressing the same and forming a homogeneous condensate which is droplet-free and is supplied thereas to the cylinder, said first means comprising a casing, the second means comprising a scroll member constituted by a driven worm in said casing, said scroll member having an inlet end and an opposite outlet end, said worm diminishing in size from the inlet end to the outlet end, and a pressure disc at said outlet end of the worm for the discharge of mixture therethrough at high pressure.

2. An improvement as claimed in claim 1 wherein said pressure disc is constituted by a plurality of segmental discs, said worm including a driven shaft, the segmental discs being mounted on the driven shaft at a slight angle with respect thereto.

3. An improvement as claimed in claim 1 comprising a heated baffle body at said outlet end of the scroll member located adjacent said pressure disc and downstream thereof.

4. An improvement as claimed in claim 3 wherein said worm includes a driven shaft, the pressure disc being mounted on said driven shaft, said baffle body having a surface facing the pressure disc which is inclined relative to said shaft.

5. An improvement as claimed in claim 1 wherein said scroll member is disposed in said casing laterally relative to the path of the mixture from the carburetor towards the cylinder, said first means further comprising a valve in said casing for controlling the flow the carburetor to the cylinder, said valve having a closed position in which the scroll member has an inlet in communication with the carburetor and an outlet in communication with the cylinder.

6. An improvement as claimed in claim 5 wherein said engine has a carburetor throttle valve for controlling the quantity of mixtures which flows to the cylinder, said valve in the casing being located downstream of the carburetor throttle valve and opening later there than, said valve in the casing opening rapidly so that upon complete opening of the carburetor throttle valve, the valve in the casing is also fully opened.

7. An improvement as claimed in claim 1 wherein said carburetor has an induction pipe, the casing including a ring projecting within the induction pipe to define an annular passage therewith which opens into the inlet end of the scroll member.

8. An improvement as claimed in claim 1, wherein said scroll member is driven externally from said engine and at a speed ratio which decreases as engine speed increases.

9. An improvement as claimed in claim 3 comprising means for providing relative vibratory movement between said baffle body and pressure disc.

10. An improvement as claimed in claim 3 wherein said pressure disc and baffle body form together with the support means therefor, a vibratory structure and means for vibrating said structure at an adjustable reasonance frequency.

11. An improvement as claimed in claim 1 wherein said first means has a first outlet for the flow of mixture directly to said cylinder and a second outlet for the flow to said cylinder of mixture passing through the second means.

12. An improvement as claimed in claim 11 wherein said second outlet includes a heated, heat insulative channel.

13. An improvement as claimed in claim 11 wherein each cylinder includes separate valves for said first and second outlets.

14. An improvement as claimed in claim 11 comprising a combustion chamber associated with the second outlet, the combustion chamber opening into said cylinder.

15. An improvement as claimed in claim 13 wherein the valve controlling the second outlet opens and closes later than the valve controlling the first outlet.

16. An improvement as claimed in claim 7 wherein said annular passage is formed only on that side of the carburetor in which the idling jets thereof are located.

17. An improvement as claimed in claim 3 comprising means for heating said baffle body with engine exhaust gas.

18. An improvement as claimed in claim 1 comprising means in the region of the scroll member for supplying water to said condensate.

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